ABSTRAK

PENGARUH VARIASI KONSENTRASI ZEOLIT ALAM TERHADAP KONVERSI LIMBAH PLASTIK CAMPURAN PP DAN LPDE MENJADI BAHAN BAKAR CAIR MELALUI PIROLISIS KATALITIK

(Rania Khoirunnisa, 2026, 55 Halaman, 15 Tabel, 14 Gambar, 4 Lampiran)

Peningkatan jumlah limbah plastik serta keterbatasan sumber energi fosil mendorong pengembangan teknologi konversi limbah menjadi energi alternatif yang berkelanjutan. Salah satu teknologi yang berpotensi untuk mengatasi permasalahan tersebut adalah pirolisis. Namun, proses *thermal cracking* pada pirolisi memerlukan energi tinggi dan menghasilkan selektivitas produk cair yang relatif rendah, sedangkan penggunaan katalis zeolit alam pada *catalytic cracking* dapat meningkatkan efisiensi perengkahan dan kualitas produk. Penelitian ini bertujuan untuk menganalisis pengaruh variasi konsentrasi katalis zeolit alam terhadap kuantitas dan kualitas produk cair hasil pirolisis campuran plastik *Polypropylene* (PP) dan *Low Density Polyethylene* (LDPE). Proses pirolisis dilakukan menggunakan campuran PP dan LDPE dengan perbandingan 70:30 dan massa umpan 2 kg pada temperatur 350°C selama 120 menit, dengan variasi konsentrasi katalis 0%, 3%, 6%, 9%, dan 12% (wt). Parameter yang dianalisis meliputi % *yield*, densitas, viskositas, nilai kalor, titik nyala dan komposisi senyawa menggunakan GC-MS. Hasil penelitian menunjukkan bahwa rendemen produk cair meningkat dari 8,40% menjadi 11,60% pada konsentrasi katalis 6%, kemudian menurun menjadi 10,75% dan 7,20% pada konsentrasi 9% dan 12%. Secara keseluruhan, produk cair memiliki rendemen 7,20–11,60%, densitas 0,7493–0,7757 g/cm³, viskositas 3,7101–4,8086 cSt, nilai kalor 46,61–46,94 MJ/kg, dan titik nyala 33–39°C. Analisis GC-MS menunjukkan bahwa produk cair terdiri atas fraksi gasoline 34,68%, kerosin 39,41%, solar 16,50%, dan *heavy oil* 9,41%. Dominasi fraksi kerosin menunjukkan bahwa produk hasil pirolisis berpotensi dikembangkan sebagai bahan bakar fraksi menengah.

Kata Kunci : *Catalytic Cracking*, *Polypropylene*, *Low Density Polyethylene*, Zeolit Alam, Variasi Katalis, Bahan Bakar Cair

ABSTRACK

THE EFFECT OF NATURAL ZEOLITE CONCENTRATION VARIATION ON THE CONVERSION OF MIXED PP AND LDPE PLASTIC WASTE INTO LIQUID FUEL THROUGH CATALYTIC PYROLYSIS

(Rania Khoirunnisa, 2026, 55 Pages, 15 Tables, 14 Figures, 4 Appendices)

The increasing generation of plastic waste and the depletion of fossil energy resources have encouraged the development of technologies for converting waste into sustainable alternative fuels. One promising technology is pyrolysis. However, the *thermal cracking* process requires high energy input and generally exhibits low selectivity toward liquid products. In contrast, the use of natural zeolite as a catalyst in *catalytic cracking* can enhance cracking efficiency and improve the quality of the resulting products. This study aimed to analyze the effect of varying natural zeolite catalyst concentrations on the quantity and quality of liquid products obtained from the pyrolysis of mixed Polypropylene (PP) and Low-Density Polyethylene (LDPE) plastics. The pyrolysis process was carried out using a PP/LDPE mixture with a ratio of 70:30 and a feedstock mass of 2 kg at 350°C for 120 minutes, with catalyst concentrations of 0, 3, 6, 9, and 12 wt%. The analyzed parameters included liquid yield, density, viscosity, calorific value, flash point, and chemical composition determined by Gas Chromatography–Mass Spectrometry (GC–MS). The results showed that the liquid product yield increased from 8.40% to 11.60% at a catalyst concentration of 6 wt%, before decreasing to 10.75% and 7.20% at catalyst concentrations of 9 wt% and 12 wt%, respectively. Overall, the liquid products exhibited yields of 7.20–11.60%, densities of 0.7493–0.7757 g/cm³, viscosities of 3.7101–4.8086 cSt, calorific values of 46.61–46.94 MJ/kg, and flash points of 33–39°C. GC–MS analysis revealed that the liquid products consisted of gasoline (34.68%), kerosene (39.41%), diesel (16.50%), and heavy oil (9.41%) fractions. The predominance of the kerosene fraction indicates that the pyrolysis oil has the potential to be further developed as a middle-distillate fuel.

Keywords: Catalytic Cracking, Polypropylene, Low-Density Polyethylene, Natural Zeolite, Catalyst Concentration, Liquid Fuel